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(54) Automatized system for the in-line detection of the losses on panels containing a cooling fluid circuit

(57) Automatized system for the in-line detection of losses on panels containing a circuit for receiving the circulation of a cooling fluid and intended for cooling air units including

- a gripper unit (2) at the end of said panel in its inlet area for the charging of gas in its interior channel;
- a sealing connection means with nozzle (3) for injecting under pressure, from a delivering means (4), a gas containing at least partly a gas detectable by means sensitive to the presence of said gas (5);
- sensor means of said gas (5) mounted in a relatively mobile way with respect to said panel (1), on which losses (11) must be detected, move by means of scanning on order to scan the concerned surface of the respective channels of said panel (1) and signalling the possible presence of a respective loss in a certain superficial position (11) on said panel (1).

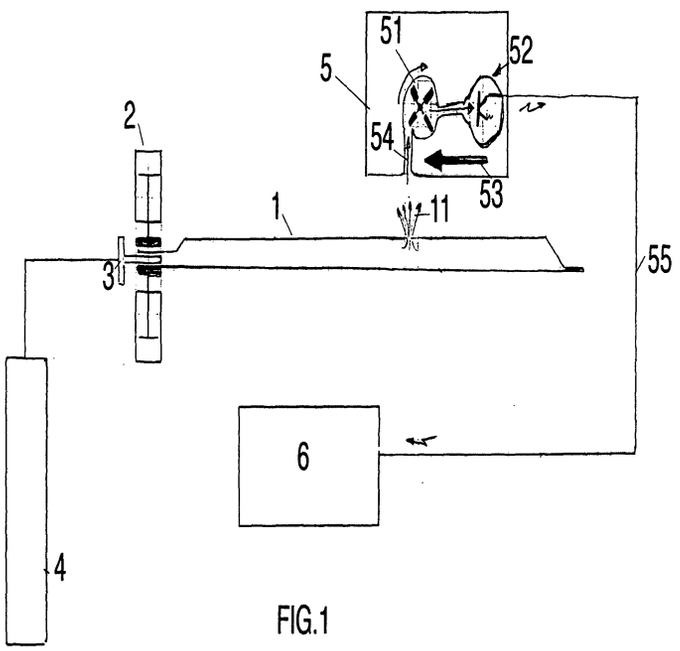

FIG.1

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Description

Object

[0001] This invention refers to an automatized system for the in-line detection of losses on panels containing a circuit for receiving the circulation of a cooling fluid and intended for cooling air units, such as for example the panels obtained for in-line production with the "ROLL BOND" process universally known in refrigerator and freezer evaporator construction technology.

Background art

[0002] The evaporator panel " ROLL BOND " is, and will be in the future one of the optimal solutions for the obtainment of a cold environment on the interior of domestic apparatuses (refrigerators and freezers).

[0003] The production process of this evaporator provides the sandwich superpositioning of two aluminium plates with an interposed design obtained by silkscreening with specially formulated ink. Said ink defines the zones in which the two superimposed plates must not connect in the preheating and lamination process that follows.

[0004] Once it has been laminated the sandwich appears as a single aluminium plate containing a design on the inside that later will become the channel within which the cooling gas will expand.

[0005] To transform said design into a channel it is necessary to blow in an air pressure between the two welded plates, on the interior of the silkscreened design, that varies depending on the complexity of the design and on the thickness of the two laminated plates that form the sandwich.

[0006] These air pressures can also reach considerable values 140 -150 bar, while the thickness of the superposed aluminum plates seldom reaches a millimetre in thickness.

Drawbacks of the current known solutions

[0007] It immediately becomes evident that, although the inflation process occurs on the interior of suitable presses that delimit the expansion of the channels submitted to said pressures, often the channel yields to the excess pressure to which it is submitted thus tearing and causing insidious losses which lead to the discarding of the blank in the first phase, but that at the same time force integral type tests to be carried out on the finished product in order to be able to guarantee the user of the airtightness of the product supplied.

[0008] These loss tests, commonly known until now as " LEAK TEST", can be carried out, with a certain reliability, only after a high level of completion of the evaporator, or only after the latter has undergone a series of works and the addition of expensive components.

[0009] Said works therefore add to the cost of a component that could potentially be rejected, a value that is lost when the test shows an unacceptable loss caused by the breaking of the channel during the inflation phase. Moreover, given that said tests are integral, they must be carried out with suitable high cost (both in terms of purchase and functioning) and low productivity apparatuses.

[0010] It is necessary to remember that if the component is not completed on the production line, but on the contrary is sold in delivery condition as a blank (squared or cut-off), the test cannot be carried out prior to delivery, but must be carried out by the end user, after the completion process with all the implications that permit the possible appearance of relevant losses.

Problem to be solved

[0011] The problem is therefore to find a system that provides the product test immediately after the inflation phase and that guarantees that the advanced product is without losses, in a simple, fast (without interrumping the normal chain production process), effective and safe way.

Solution to the problem according to the present invention

[0012] The problem is solved with a system according to the characteristics of the main claim, the subclaims constituting the preferred embodiments.

Advantages of the new solution

[0013] The solution to the problem consists in the application of a hydrogen sensor, of a commonly known type available on the market, to a scanning system capable of analysing in-line the inflated panel and supplying results with a sensitivity so as to guarantee that the panel under consideration is free of microlosses, allowing not only in-line automatic production, but also the total control to 100 % of its tightness, thus guaranteeing supply.

[0014] In essence, pressurizing the panel channels after being connected, with a tracer gas mixture (nitrogen 95% hydrogen 5%) and passing it through said channels with an aspirator equipped with a hydrogen sensor, the presence of a percentage of hydrogen higher than a defined threshold (background noise) indicates the loss of tracer gas and therefore the presence of a perforation.

[0015] Therefore, this process can be carried out in-line without adding any complication or obstacle to the normal production cycle.

[0016] This solution guarantees that all the inflation processed panels are free from microlosses and therefore can be supplied to successive works as safe and tested panels that will not be the source of subsequent tearing due to airtightness faults in the inflated channel.

[0017] This technological plus adds value to the product in that it allows the elimination of the defective panels at the source and prevents the latter from reaching further working stages.

[0018] For these reason the panels (above all those squared or cut-off) can be sold with the tested product label " FIELD LEAK TESTED", certifying that the panel has undergone the above-described test.

Description of a preferred solution

[0019] The invention will be now described in detail with the aid of the included Figure 1 illustrating a scheme of the system according to the invention.

[0020] As seen in Figure 1, the system includes:
Gripper unit (2-3) with pressure gas feed device (4) in the panel (1) made up of:

- gripper or vice for pressurizing the panel to be mounted under the discharge bench press (2) made up of:

- pneumatic lever for positioning in correspondence to the gripper carrying arm.
- grippers with pneumatic grip
- gas pressured charge nozzle (3) within the panel (1), the gas being made up of nitrogen + hydrogen originating from gas bottle storage (4).
- micro-fumehood above the gripper and respective gripper area and connection for the feeding of the gas underpressure (4) to the panel (1), not illustrated.

[0021] The gripper (4) is collapsible (under the bench) and emerges from it centrally, after the passing of the panel during the discharge operation of the panel (1) to be checked.
The position of the gripper (2) is fixed.

[0022] The nozzle (3) is mounted centrally and has a diameter that facilitates the entrance of the inflated panel (1) when it is pushed against it.

[0023] The lateral alignment of the panel (1) is guaranteed by adequately modified discharge joggers (not illustrated, but technology known to the those skilled in this area).

[0024] The vertical alignment of the panel (1) is guaranteed by suitable guides (not illustrated), within which the panel is confined.

[0025] Once the nozzle is fitted, the gripper with plastic jaws (2) provides the connection sealing.

[0026] Moreover, the weak suction produced by said connection covering hood (not illustrated), guarantees the rapid scavenging of possible small losses in the gripping-sealing area.
Scanner unit (5) mounted on a trolley made up of:

- two tempered lateral guides of suitable length (4,5 metres) (not illustrated)
- trolley (53) sensor unit carrier (5) sliding on guides by alternating scanning movement and pulled by a chain with relative coils and cranks (not shown, but commonly known in the art of scanning).
- fixed geared motor and pinion with absolute encoder brushless motor machine .
- panel (1) pusher with pneumatic activation (not shown)
- hydrogen sensor (52) connected to hydrogen meter (55-6), suction micropump unit (51), gas suction nozzles (54) for the detection of loss (11) and discharge. The hydrogen sensor (52) is connected to a loss signal transmission cable (55), by means of a chain cable carrier (not illustrated).

[0027] The scanner (5), being mounted on the trolley, slides on two guides fixed on the discharge bench and positioned parallel to the motion of the panel to cover the entire length of the bench and be able to follow the possible forward movement of the panel in the case of in-line production.

[0028] In this specific case, the motorization of the scanner can take place on the trolley by means of the pulling of a chain and a series of returning coils of which one is motorized with brushless and encoder for the relief of the position (known art solutions not illustrated).

[0029] The trolley in the resting position is at the end of its travel at a distance from the inflation press.

[0030] When the panel (1) is removed from the press (for deformation, formation of the channel, not illustrated, known in the art and of no specific interest to the present invention, in forming part of the normal in-line manufacturing process of the panel), and the gripper carrying arm of said gripper unit (3-2) is in position, the support trolley of the respective panel (1) begins its upward stroke (toward the gripper unit 2-3) with a push blade in the "low" position. Said blade pushes the inflated panel until it fits onto the test gas inlet gripper (2-3).

[0031] Once the test position is reached, the blade is raised and the trolley with the panel (1) can reach the test start position.

[0032] The gripper (2) closes and supplies the test gas by means of the connection (3) to the already inflated panel orginating from the previous inflation station (known art not illustrated) in the normal in-line "ROLL-BOND" production processes.

[0033] Once the panel (1) is filled with gas containing hydrogen, the panel-carrying trolley (1) inverts its own motion and the loss sensor unit sensitive to hydrogen (5) is activated.

[0034] The inflated panel full of nitrogen and hydrogen under pressure (1), is sounded along its entire length until reaching the limit switch position, in the case of a detected loss the sensor (5) stops and sends a signal of "stop cycle after inflation" to the press upstream to allow the recognition of the perforated panel.

[0035] Connected to the system are means for the in-line advancement synchronisation in cooperation with

the workstations, particularly upstream (press).
In particular:

- feeding test gas synchronized with measuring operations for example with a measuring unit (6) for reading the scanner (5) signals;
- activation for brushless motor;
- software synchronization of the press cycle with the cycle test and discharge piece.

[0036] The start of the test cycle occurs by means of the inflated panel overcoming a sensor placed on the discharge bench panel.
[0037] Said sensor, conveniently optoelectronic, guarantees that the panel (1) is in a position ready for use for the start of the test cycle.
Cycle times

- Positioning of the open gripper (high) 1 sec.
- Movement of the scanner towards the plate with blade downwards 3 sec.
- Slowdown and alignment with blade upwards 3 sec.
- Closure of the vice (2) and test gas inlet while the scanner (5) reaches the start position test 5 sec.
- Start scanning at constant speed (200 mm/second) 15 sec.
- Limit switch panel (1) reaching the starting position (limit switch at a distance from the press) 3 sec.
- Maximum time provided 30 sec.

[0038] However, the details, the cycle parameters and adaptation to the line can obviously vary.

Claims

1. Automatized system for the in-line detection of losses on panels (1) containing a circuit for receiving the circulation of a cooling fluid and intended for cooling air units,
characterized in that the following are connected to production line of said panels (1):

   - a gripper unit (2) of the end of said panel in its inlet area for the charging of gas in its interior channel;
   - a sealing connection means with nozzle (3) to inject under pressure, from a delivering means (4) a gas containing at least in part a gas detectable by sensor means sensitive to the presence of said gas (5);
   - sensor means sensitive to said gas (5) mounted in a relatively mobile way with respect to said panel (1), on which losses (11) must be detected, by scanning means to scan the concerned surface of the respective channels of said panel (1) and able to signal the possible presence of a respective loss in a certain superficial position (11) on said panel (1).

2. System according to claim 1, **characterized in that** said gripper unit includes opposing jaws of substantially plastic material to form a seal in the connection area with said charging nozzle of detector gas (3-4).

3. System according to any previous claims, **characterized in that** said detector gas feeding system is a bottle of compressed gas (4).

4. System according to any of the previous claims, **characterized in that** said detector gas includes hydrogen.

5. System according to any of the previous claims, **characterized in that** said detector gas includes a mixture of inert gas.

6. System according to any of the previous claims, **characterized in that** the said detector gas includes a mixture with nitrogen.

7. System according to any of the previous claims, **characterized in that** said detector gas is hydrogen and said sensor means of said gas (5.52,53,55,,6) are sensitive to the presence of hydrogen

8. System according to any of the previous claims, **characterized in that** above the gripper and connection area (2-3) a fume hood is provided.

9. System according to any of the previous claims, **characterized in that** above the range area of said sensor means of said gas (5) a fume hood is provided.

10. System according to any of the previous claims, **characterized in that** said sensor means of said gas (5) are movable on a trolley in order to scan said panel (1)

11. System according to any of the previous claims, **characterized in that** said sensor means of said gas (5) include a gas suction feed opening (54) directed towards the surface of the panel to be scanned (1), connected to a suction pump (51) that conveys the sucked gas to a sensor means of the detector gas (52).

12. System according to the previous claim, **characterized in that** said detector gas sensor means (52) is connected to a quantity meter of detector gas (6) for the management and regulation of the system.

13. Plant for the production of panels (1) containing a circuit for receiving the circulation of a cooling fluid

and intended for cooling air units, **characterized in that** it includes a loss detection system in said circuit (11) according to any of the characteristics of the claims from 1 to 12.

14. Plant for the production of panels (1) containing a circuit for receiving the circulation of a cooling fluid and intended for cooling air units, according to the previous claim, **characterized in that**, it includes a loss detection system in said channel (11) according to the characteristics of any of the claims from 1 to 12, downstream of the respective station for panel pressing and inflation (1) for the formation of the respective channels.

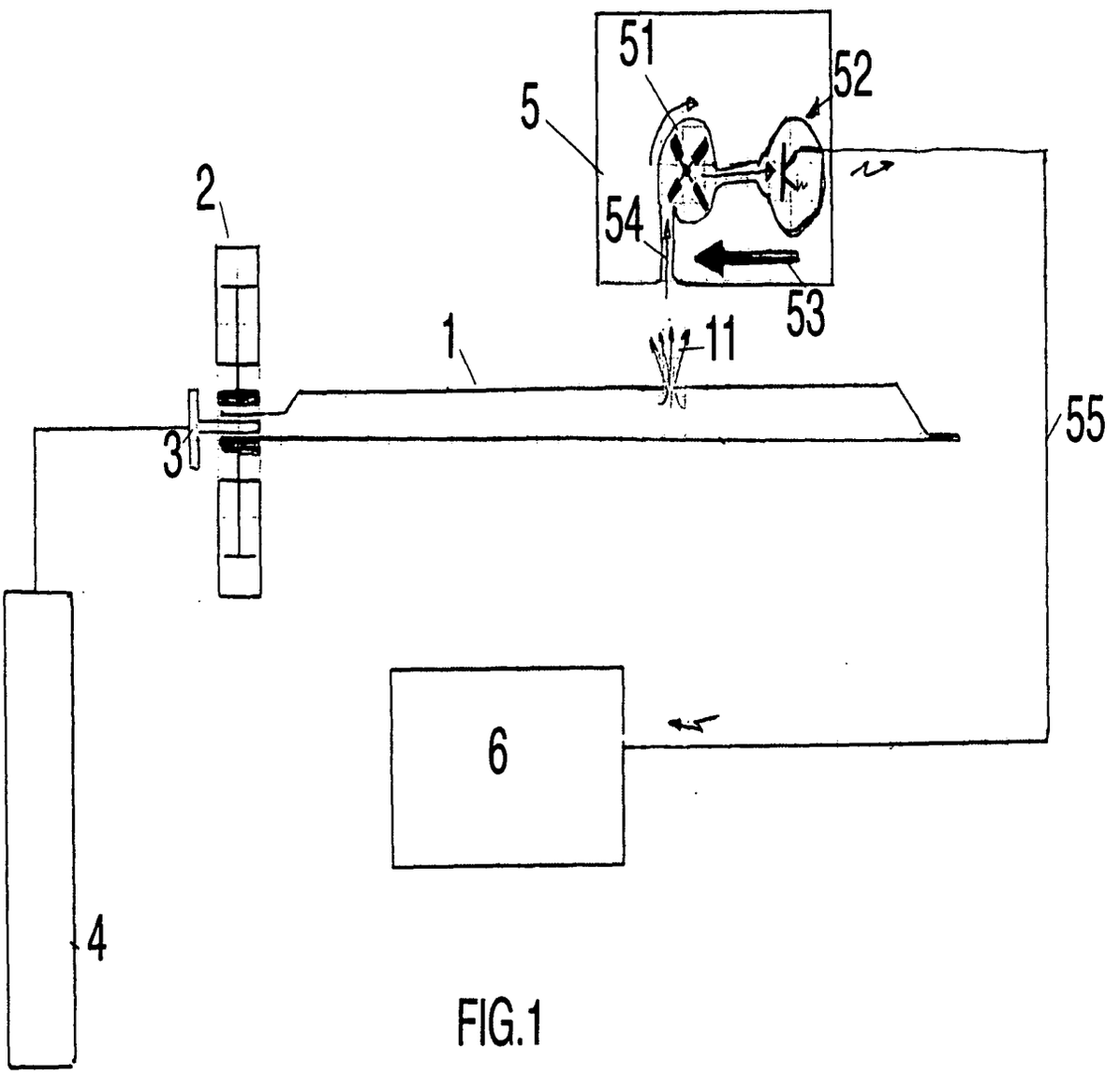

FIG.1